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GENETIC VARIABILITY AND HERITABILITY STUDIES IN RELATION TO SEED YIELD AND ITS COMPONENT TRAITS IN BLACKGRAM (VIGNA MUNGO(L.) HEPPER

CIRIVELA SHIRIN* & G. M. LAL

Department of Genetics and Plant Breeding, Naini Agriculture Institute

Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj,

Uttar Pradesh, India-211007

ABSTRACT

During Kharif 2020, the current research was conducted at the Experimentation Centre, Department of Genetics and Plant Breeding, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Science, Prayagraj, utilizing 38 genotypes. The genotypes were implanted in Randomized Block Design (RBD) with three replications. Analysis variability parameters, correlation coefficients, and path coefficients were applied to the average results. Based on the mean performance, high yield was found for the PKRU-03, KC-153, PDU-6, JU-2 showed higher than the check variety (T-9). Present experimental findings revealed that character's viz., number of clusters per plant, seed index, plant height, and number of primary branches per plant exhibited high GCV, PCV and heritability is coupled with high genetic advance as per cent of mean need to be given care while formulating breeding strategies for improvement of seed yield of blackgram.

KEYWORDS: Genetic variability, Heritability, Genetic advance

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INTRODUCTION

Pulses are an essential source of protein for particularly vegetarian population of our country and they constitute a major part of our daily diet. Pulses have also been shown to improve soil fertility and crop productivity. The domestication and cultivation of staple food crops received more consideration than pulses. Pulses are perennially produced on low-fertility, moisture-stressed fields, thus genotypes are more adaptable to inadequate management, resulting in restricted output. This does not imply that pulses have little genetic potential; in fact, they may have better genetic potential than cereals. Blackgram [Vigna mungo (L.) Hepper], is a short-term grain legume that is economically valuable. It is a member of the family Fabaceae and subfamily Papillionaceae with chromosome no 2n= 22. Its Centre of origin is India. Vigna radiate var. sublobata is thought to be the ancestor of blackgram.

Area, Production, Productivity of Blackgram

According to the 2019-20 census, blackgram occupies an area of 50.31 lakh/ha with production of 32.84 lakh tonnes and productivity of 653 kg/ha whereas in Uttar Pradesh it occupies an area of 5.88 lakh/ha with production of 3.05 lakh tonnes and productivity of 520 kg/ha.

Source: directorate pulse development Ministry of agriculture & farmers welfare 2019-20.

ECONOMIC IMPORTANCE

Blackgram is an important pulse crop that is planted all over India. It's eaten as dal (whole or split, husked or unhusked) or perched. Urd is unique among pulses in that when soaked in water, it develops a mucilaginous pasty texture. It is consumed in a variety of ways across the North to South in preparation of different regular and popular dishes like vada, idli, dosa, halwa, imarti in combination with other food grains. Also used as nutritive fodder for mulch cattle.

India is the world's largest producer as well as consumer of Blackgram. It produces about 3.06 million tonnes of Blackgram annually from about 4.49 million hectares of area with an average productivity of 681.51 kg per hectare **(Directorate of Economics and Statistics, Ministry of Agriculture and Farmers Welfare 2019-20).**

The per capita availability of pulses has declined from 60.7gm/day in 1951 to 48 gm/day in 2019 as against the FAO/WHO‟s recommendation of 80gm/day **(Economic Survey, 2019-20)**. In this regard, the production potential of the blackgram crop can be increased by using targeted hybridization programmes to generate high yielding genotypes.

Seed yield being a complex character is influenced by several genetic factors interacting with the environment. A clear understanding of the association of plant characters with yield is necessary for a successful crop improvement programme. The correlation coefficient reflects the size and direction of the yield component relationship. Correlation coefficient analysis reveals the component characters on which selection can be based for yield improvement by measuring the mutual correlations between distinct plant character pairs. Character association aids in the development of productive genotypes by assisting in the formulation of an appropriate breeding plan.

MATERIALS AND METHODS

The experimental material for the present investigation consisted of 38 genotypes obtained from the Department of Genetics and Plant Breeding, SHUATS, Prayagraj. The experiment was carried out at the Field Experiment Centre of the Department of Genetics and Plant Breeding, SHUATS, Prayagraj during *Kharif*, 2020, which is nearly 5km away from Prayagraj city and is very near to river Yamuna. The site is located at 25.28 N latitude, 81.54 E longitude and 98 meters above sea level. Soil texture Prayagraj comes under middle Gangetic plains (Agro climatic zone IV). The soil in this area is sandy loam, which is slightly alkaline. To raise a healthy crop, recommended cultural techniques were followed. Five competitive plants from each genotype were chosen at random for recording observations on thirteen features, including days to 50% flowering, days to 50% pod setting, days to maturity, plant height(cm), number of primary branches per plant, number of clusters per plant, number of pods per plant, pod length(cm), number of seeds per pod, biological yield per plant (g), harvest index (%), seed index (g) and seed yield per plant (g). The conventional approach for analysis of variance was followed (Fisher, 1938). Genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) (Burton, 1952), heritability (Burton and Devane, 1953), genetic advance (Johnson *et al*., 1955), were estimated.

RESULTS AND DISCUSSION

The analysis of variance for yield and yield contributing characters are presented in **Table 1**. The mean sum of squares due to genotypes was highly significant for all the traits studied in this investigation. Thus it reveals the presence of substantial amount variability among the genotypes under study.

The mean values, coefficient of variation (C.V), standard error of mean, critical differential (C.D) at 5%, range of 38 genotypes and 13 quantitative characters are presented in **Table 2**, the perusal data revealed a wide range of variation

for all traits studied *viz.*, days to 50% flowering range from 41.00 days (KC-153) to 49.66 days (VBN-08), days to 50% pod setting range from 52.667 days (PLU-856) to 62.733 days (PDU-103), pod setting range from 62.033 days (IC-91-567) to 71.8 days (ADT-3), plant height range from PLU-1016 (45.60cm) to DH-85-2(83.193cm), number of primary branches range from BG-369 (2.733) to PLU-302 (9.800), number of cluster per plant range from BG-369(3.667) to P-1 (27.867), number of pods per plant range from IC-91-567 (9.067) to PKRU-03 (47.967), number of seeds per pod range from PKGU-03 (4.833) to TBG-104 (7.867), pod length range from PDU-6 (3.6) to BG-369 (4.76), seed index ranged from PKGU-03 (2.367) to TBG-104 (5.800), biological yield ranged from LBG-752(7.013) to PKRU-03(21.743), harvest index ranged from LBG-648(21.133) to BG-369(46.000), seed yield per plant ranged from PLU-302 (3.013) to IPU-99-16(4.533).

Genotypic and Phenotypic Coefficient of Variation

The estimates of variability parameters for various yield and yield related traits are presented in Table 3. An estimate of GCV and PCV revealed the phenotypic coefficient of variation was higher than genotypic coefficient of variation, which indicates the presence of environment effects on expression on character studied. Higher magnitudes of PCV were recorded for number of cluster per plant (47.541) followed by number of branches per plant (42.984), number of pods per plant (40.366), harvest index (27.767). Moderate magnitude of PCV were recorded for seed yield per plant (26.73) followed by plant height (24.003), biological yield (21.454), seed index (20.233) no. of seeds per pod (11.975). Low magnitude of PCV were recorded for plant length (7.239) followed by days to 50% pod setting (5.465), days to 50% flowering (4.479), days to maturity (2.564).

Higher magnitude of GCV were recorded for number of cluster per plant (40.298) followed by number of branches per plant (39.994), number of pods per plant (34.997), plant height (20.025), harvest index (19.852). Moderate magnitudes of GCV were recorded for seed yield per plant (19.784), seed index (17.816), biological yield per plant (12.59), number of seeds per pod (9.108). Low magnitudes of GCV were recorded for days to 50% pod setting (4.693), pod length (4.35), days to 50% flowering (3.36), days to maturity (2.225).

Heritability (%) and Expected Genetic Advance

The perusal of table 3 revealed the estimates of heritability (%) in broad sense for 13 characters studied, which ranged from (34.4%) to (86.6%). Number of branches per plant (86.6%), seed index (77.5%), showed high heritability. Moderate heritability days to maturity (75.3%) when compared to other genetic parameters for heritability. Low heritability was recorded for number of pods per plant (75.1%), days to 50% pod setting (73.7%), number of cluster per plant (71.8%), plant height (69.6%), number of seeds per pod (57.8%), days to 50% flowering (56.3%), seed yield per plant (54.8%), harvest index (51.1%), pod length (36.1%), biological yield per plant (34.4%).

High estimate of genetic advance as per cent of mean was recorded for number of branches per plant (76.658), number of cluster per plant (70.364), number of pod per plant (62.433), plant height (34.414). Moderate estimate of genetic advance as percent of mean was recorded for seed index (32.315), seed yield per plant (30.164), harvest index (29.239), biological yield per plant (15.221), number of seeds per pod (14.271). Low estimate of genetic advance as percent of mean was recorded for days to 50% pod setting (8.3), pod length (5.386), days to 50% flowering (5.192), days to maturity (3.978). This indicated that in blackgram, there is a higher chance to increase yield and characteristics.

CONCLUSIONS

The experimental results conducted that based on field performance of 38 genotypes of blackgram the highest yield was recorded in PKRU-03(7.627g) and identified as desirable genotype with seed yield per plant compared with T-9(4.580g). All genotypes mature early than check variety. The higher magnitude of GCV and PCV were recorded for number of clusters per plant and number of primary branches per plant for heritability and genetic advance were plant height. Thus, priority should be given to these characters for yield improvement in blackgram.

Table 1: Analysis of Variance for 13 different Quantitative Characters in 38 Genotypes of blackgram

CHARACTERS	MEAN SUM OF SQUARES		
	Replication	Treatments	Error
	(df = 2)	(df =37)	(df = 74)
Days to 50% flowering	25.15	8.75	1.80
Days to 50% pod setting	16.40	24.29	2.57
Days to maturity	17.31	7.97	0.78
Plant height	41.11	471.55	59.93
No. of primary branches per plant	4.87	13.53	0.66
No. of clusters per plant	44.81	83.38	9.63
No. of pods per plant	43.17	241.39	24.04
No. of seeds per plant	2.28	1.24	0.24
Pod length	0.18	0.17	0.06
Seed index	0.051	1.93	0.17
Biological yield	9.27	24.70	5.97
Harvest Index	79.48	96.07	37.29
Seed yield per plant	3.27	2.78	0.60

** 1% Level of significance and * 5% Level of significance

Table 2: Mean Performances of 38 blackgram Genotypes for 13 Quantitative Characters

Sl. No.	Genotypes	Days to 50% Flowering	Days to 50% Pod Setting	Days to Maturity	Plant height (cm)	Number of Primary Branches Per Plant	Number of Clusters Per Plant	Number of Pods Per Plant	Number of Seeds Per Pod	Pod Length (cm)	100 seed Weight (g)	Harvest Index (%)	Biological Yield Per Plant (g)	Seed Yield Per Plant (g)
1	PKRU-03	45.667	55.000	69.260	81.100	3.800	14.867	47.967	5.600	4.613	3.400	35.363	21.743	7.627
2	LBG -648	44.333	56.667	69.390	79.953	3.167	5.267	18.667	5.600	4.507	3.700	21.133	16.777	3.520
3	FDU-6	46.333	56.333	69.370	79.920	3.367	15.300	44.200	5.667	3.647	3.300	37.060	15.787	5.867
4	DH -85-2	46.000	55.000	69.017	83.193	3.433	4.700	23.100	5.833	4.420	3.633	25.533	13.283	3.403
5	KC -153	41.000	53.667	68.580	75.460	3.200	16.067	43.267	5.900	4.493	4.500	34.107	17.703	6.053
6	PGRU-99022	45.667	56.000	69.583	73.967	3.300	6.567	25.400	5.500	4.360	3.167	33.290	12.730	4.240
7	VBN-08	49.667	57.000	70.213	68.693	2.767	6.567	28.333	5.367	4.483	4.500	31.780	15.570	4.853
8	SNTP-02	44.667	54.000	69.467	75.187	3.567	7.133	26.467	5.333	4.493	4.333	29.580	13.050	3.833
9	BG-369	42.000	53.333	68.413	70.407	2.733	3.667	18.667	6.100	4.760	4.367	46.000	9.720	4.247
10	PLU-557	46.000	55.333	70.070	56.607	3.033	9.667	27.433	6.067	4.447	4.700	36.383	9.943	3.587
11	PKGU -03	43.667	55.000	70.133	46.200	2.967	7.667	21.833	4.833	4.217	2.367	35.097	11.043	3.727
12	PLU -856	47.000	52.667	68.310	76.900	2.933	7.400	23.267	6.600	4.293	3.467	45.657	12.173	5.223
13	PLU - 1050	45.800	56.933	69.163	52.800	3.533	16.000	25.600	6.400	4.460	4.100	30.130	12.417	3.740
14	TAU-1	45.867	57.333	69.473	51.467	3.933	6.400	11.267	5.867	4.080	4.067	31.733	10.460	3.320
15	IPU-99-16	45.733	57.133	70.390	55.533	5.533	20.467	33.600	6.133	4.313	6.200	36.407	12.487	4.533
16	PLU -1016	43.600	53.333	69.163	45.600	3.600	11.067	16.400	7.067	4.587	4.133	40.370	11.607	4.607
17	NP-16	46.533	58.200	70.213	52.467	3.733	15.333	26.733	6.400	4.607	5.367	36.563	13.210	4.833
18	FDV -2	45.867	57.333	69.370	51.220	7.333	15.133	22.843	6.400	4.200	4.700	31.377	10.613	3.327
19	LBG -752	44.533	55.600	69.393	47.667	5.133	11.267	15.867	6.533	4.687	5.733	46.597	7.013	3.260
20	IC -91-567	47.333	59.133	62.033	58.600	9.033	8.467	9.067	6.133	4.333	4.567	31.047	9.940	3.087
21	JU-2	44.933	56.000	69.017	48.667	5.733	14.567	23.767	6.400	4.433	4.000	34.863	15.083	5.233
22	BGP -21-28	43.467	54.333	68.413	48.867	5.600	10.933	18.400	6.533	4.400	3.033	36.757	13.510	4.967

Sl. No.	Genotypes	Days to 50% Flowering	Days to 50% Pod Setting	Days to Maturity	Plant Height (cm)	Primary Branches Per Plant	Clusters Per Plant	Number of Pods Per Plant	Number of Seeds Per Pod	Pod length (cm)	100 seed Weight (g)	Harvest Index (%)	Biological yield (g)	Seed Yield Per Plant (g)
23	LBG – 20	47.067	59.067	69.393	49.667	7.667	14.800	24.533	6.733	4.720	4.867	40.507	13.277	5.220
24	PLU-144	45.867	57.267	70.070	34.067	4.133	8.867	19.133	6.733	4.287	4.133	41.023	12.163	4.987
25	VBN – 6	45.400	56.800	70.213	43.933	5.667	9.533	15.800	6.533	4.373	3.900	41.977	11.063	4.613
26	ADT-3	47.067	61.467	71.800	46.533	6.267	15.867	29.133	6.933	4.693	4.000	35.220	11.893	4.200
27	DH -85-5	45.267	62.667	71.370	57.267	7.400	14.467	20.933	6.400	4.480	4.233	39.173	7.127	2.740
28	LBG -645	47.067	61.467	70.213	47.267	9.067	20.800	33.133	6.400	4.287	5.033	37.133	10.130	3.753
29	PLU -302	45.200	59.133	69.863	62.200	9.800	14.133	18.267	6.267	4.040	4.167	30.927	9.750	3.013
30	MASH -338	47.067	62.133	71.487	50.467	8.667	22.667	32.400	7.667	4.927	4.133	39.353	11.177	4.400
31	P-1	47.200	61.800	71.487	55.467	9.400	27.867	41.867	6.067	4.133	4.700	38.467	9.790	3.767
32	SPS -40	44.133	56.800	69.360	50.200	7.800	12.133	19.600	6.400	4.133	4.533	30.253	12.603	3.780
33	TBG -104	45.600	62.533	70.213	58.067	5.533	12.933	19.867	7.867	4.873	5.800	25.987	15.460	3.753
34	SN -2115	42.267	58.000	71.800	48.783	4.867	13.133	22.200	7.267	4.580	4.167	29.923	14.103	4.273
35	PDU -103	45.067	62.733	71.370	51.200	4.733	11.400	20.267	7.067	4.360	5.500	36.290	13.277	4.727
36	CO -6	44.733	59.533	70.510	55.567	5.667	12.600	17.400	6.467	4.380	3.667	30.667	16.500	4.980
37	IPU – 1070	42.267	55.000	69.737	65.517	4.667	6.400	11.867	7.200	4.547	5.267	31.223	12.527	3.907
38	T-9©	45.400	56.800	66.967	66.133	4.000	15.467	26.200	6.867	4.453	4.200	41.050	11.590	4.580
	Mean	**45.325**	**57.330**	**69.587**	**58.495**	**5.178**	**12.304**	**24.335**	**6.346**	**4.424**	**4.306**	**35.158**	**12.587**	**4.310**
	C.V.	2.962	2.802	1.274	13.235	15.751	25.225	20.150	7.775	5.786	9.591	17.371	19.414	17.975
	F ratio	4.861	9.416	10.149	7.867	20.342	8.657	10.039	5.117	2.696	11.351	2.576	4.137	4.634
	F Prob.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	S.E.	0.775	0.927	0.512	4.470	0.471	1.792	2.831	0.285	0.148	0.239	3.526	1.411	0.447
	C.D. 5%	2.184	2.613	1.443	12.596	1.327	5.049	7.978	0.803	0.416	0.672	9.936	3.975	1.260
	C.D. 1%	2.898	3.467	1.914	16.713	1.761	6.700	10.586	1.065	0.553	0.892	13.184	5.275	1.672
	Range Lowest	41.000	52.667	62.033	34.067	2.733	3.667	9.067	4.833	3.647	2.367	21.133	7.013	2.740
	Range Highest	49.667	62.733	71.800	83.193	9.800	27.867	47.967	7.867	4.927	6.200	46.597	21.743	7.627

Table 3: Genetic Parameters for 13 Characters of 38 blackgram Genotypes

Character¤	Genotypic Variance (Vg)¤	Phenotypic Variance (Vp)¤	GCV¤	PCV¤	Heritability (%)Broad sense¤	GA¤	GA as % mean¤
Days to 50% flowering¤	2.319¤	4.121¤	**3.36**¤	4.479¤	56.3¤	2.353¤	5.192¤
Days to 50% pod setting¤	7.238¤	9.817¤	4.693¤	5.465¤	73.7¤	4.758¤	8.3¤
Days to maturity¤	2.398¤	3.184¤	2.225¤	**2.564**¤	75.3¤	2.768¤	**3.978**¤
Plant height¤	137.206¤	197.145¤	20.025¤	24.003¤	69.6¤	20.13¤	34.414¤
No. of branches per plant¤	4.289¤	4.954¤	39.994¤	42.984¤	**86.6**¤	3.969¤	**76.658**¤
No. of cluster per plant¤	24.585¤	34.219¤	**40.298**¤	**47.541**¤	71.8¤	8.658¤	70.364¤
No. of pods per plant¤	72.449¤	96.494¤	34.997¤	40.366¤	75.1¤	**15.193**¤	62.433¤
No. of seeds per pod¤	0.334¤	0.577¤	9.108¤	11.975¤	57.8¤	0.906¤	14.271¤
Pod length¤	0.037¤	0.103¤	4.35¤	7.239¤	36.1¤	**0.238**¤	5.386¤
Seed index¤	0.589¤	0.759¤	17.816¤	20.233¤	77.5¤	1.392¤	32.315¤
Biological yield¤	19.594¤	56.891¤	12.59¤	21.454¤	**34.4**¤	5.351¤	15.221¤
Harvest index¤	6.244¤	12.215¤	19.852¤	27.767¤	51.1¤	3.68¤	29.239¤
Seed yield per plant¤	0.727¤	1.327¤	19.784¤	26.73¤	54.8¤	1.3¤	30.164¤

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